1. INTRODUCTION

Guar is an important commercial and export crop of Pakistan. Guar or cluster bean is believed to have originated in Africa but is been grown throughout southern Asia since ancient times as a vegetable and fodder crop. Guar has been cultivated in India and Pakistan for ages for use of its green pods as vegetable, grains as pulse and green plants as fodder and for soil manuring purpose. The plant is extremely drought-resistant, being able to absorb efficiently all ground water. It grows therefore easily in those semi-arid regions where less hardy crops perish. The major world supplier of guar seed are India, Pakistan and United States. Like other legumes guar is an excellent soil-building crop with respect to available nitrogen.
2. USES

**Green manure:** Guar plantings increase the yield of subsequent crops as this legume conserves soil nutrient content.

**Cattle feed:** The guar meal following extraction is good high-protein feed, but as a hay or forage guar appears inferior to many other legumes. In the past Guar used to feed to cattle or used as a green manure but the use as cattle feed is now rare due to the rising cost.

**Guar Gum:** Guar Gum is a white to yellowish white powder. It is nearly odorless. Fine finished Guar Gum Powder is available in different viscosities and different granulometries depending on the desired viscosity development and application. The endosperm can account for more than 40% of the seed weight and is separated and ground to form commercial guar gum.

**Gum uses in Beverages:** Manufacturers of fruit beverages, mayonnaise and ketchup have access to a new range of guar gum replacers just launched by Premium Ingredients.

**Guar Gum in food:** Guar is the main source of guar gum. Guar gum is a dietary fiber obtained from the endosperm of the cluster bean. Guar beans have a large endosperm that contains galactomannan gum, a substance which forms a gel in water. This is commonly known as guar gum and is used in dairy products like ice cream and as a stabilizer in cheese and cold-meat processing. Guar gum powder is used in the production of bread. Even small quantities of guar gum powder added to the dough increase the yield, give greater resiliency, improve texture and give longer shelf life. Guar Gum can be used as stabilizer for chocolate drinks, fruit nectars, and juices.

**Guar Gum Industrial uses:** Derivatives of guar gum used in industrial applications such as the paper and textile industry, ore flotation, the manufacture of explosives and hydraulic fracturing of oil and gas formations.

**Guar Gum as a medicine:** Guar gum is a food additive shown to reduce serum cholesterol. It appears to have positive effects on blood glucose.

3. GROWTH HABITS

Guar is an upright, coarse-growing summer annual legume known for its drought resistance. Most of the improved varieties of guar have glabrous (smooth, not hairy) leaves, stems and pods. Plants have tap root system, single stems, fine branching or basal branching (depending on the variety) and grow to be 25 to 45 inches tall. Racemes are distributed on the main stem and lateral branches. Pods are generally 1.5 to 4 inches long and contain 5 to 12 seeds each. Seeds vary from dull-white to pink to light gray or black.
4. CLIMATE

Guar is a photosensitive crop. It grows in specific climatic condition, which ensure a soil temperature around 25°C for proper germination, long photo-period, with humid air during its growth period and finally short photo-period with cool dry air at flowering and pod formation. Accordingly, it is definitely a kharif season crop of Pakistan but some varieties have been found to grow during February to June as spring-summer crop and other varieties grow during July to August as rainy season crop under South Pakistan climatic conditions. It is a crop preferring warm climate and grows well in the subtropics during summer.

It also grows well in arid zone with 30 – 40 cm rainfall. Heavy rains, producing waterlogged condition or more compact soils disturb its root system with surface feeding nature and reduce nitrogen fixing bacterial activity.

5. SOIL

The guar crop prefers a well-drained sandy loam soil. It can tolerate saline and moderately alkaline soils with pH ranging between 7.5 and 8.0. Heavy clay soils, poor in nodulation and bacterial activities are not suitable for this crop.

Soils with medium to light constituents without excessive moisture are suitable for its cultivation. Even soils with poor fertility and depleted plant nutrients are suitable for growing Guar as a green manure crop. Pasture lands receiving little care can also be used for growing guar mixed with grasses.

6. LAND PREPARATION

Guar crop requires a well prepared field with adequate soil moisture for its seed germination. During early growth period soil aeration encourages root development and bacterial growth. Therefore field should be ploughed to fine tilth by giving two or three deep ploughing with soil-turning plough followed by harrowing and planking. The field should be free from weeds and other crop residues. Arrangements for drainage channel-cum-water channel for heavy rain-fall areas or irrigated areas should be made while preparing the field. The farmyard manure should be mixed with soil at the time of last ploughing.

7. SOWING TIME

To earn more money from green pods as vegetable it can be grown from February – March. For green fodder and green manuring, the crop is grown during the months of April to July but for seed purpose best time of sowing is May to July. In rainfed areas the sowing is done after the monsoon rains.
8. SOWING METHOD

Before Guar sowing field should be pre-irrigated with 1 – 2 acre inch irrigation to fill soil profile. For seed drilling, light harrowing with planking is necessary to preserve the soil moisture. If the crop is sown for fodder purpose or green manuring then broadcasting is done but if it is sown for seed purpose then drilling is better and this results in better seed germination. Line sowing is also useful for carrying out hoeing-weeding and removing excessive rain water.

A spacing of 30 – 45 cm between rows and 15 cm, between plants is given for crops grown for grain production. However, spacing is generally reduced under late sowing and poor soil fertility conditions. Closer spacing of 30 x 12 cm is provided for fodder crop. A wider spacing of 60 x 30 cm is desirable for crops grown for green vegetable pod production. A planting depth of 1 to 1 1/2 inches is usually recommended.

9. VARIETY SELECTION

In Pakistan two varieties of Guar are developed for fodder and grain purpose i.e. BR – 90 and BR – 99. The developed cultivars are much more insect pest resistant with higher yields. Pod set in improved varieties is higher and pods are well distributed on the main stem and branches increasing harvest efficiency. The multiple branching of these newer cultivars also produces more pods. Crop takes 110 – 120 days to mature after sowing. Plant height at maturity is 110cm.

10. SEED RATE

Seed rate of guar crop varies from 15 kg to 45 kg per hectare depending upon soil moisture and spacing. About 20 kg seed per hectare is sufficient for grain crop. Seed rate for crops grown for fodder or green manuring is about 40 kg per hectare. Seed rate is normally increased under late sown condition, dry condition, and soil salinity or alkalinity conditions.

11. INOCULATION OF SEED WITH BACTERIAL CULTURE

Guar plant develops nodules on its roots in which is a special kind of bacteria lives and convert the free nitrogen of the atmosphere into a form of fertilizer which is absorbed by the roots of the plant. This symbiotic relation of the bacteria and root nodules is useful in saving cost of nitrogenous fertilizers. Therefore, before sowing the seeds are inoculated with these bacteria, so that their population increases in the soil with the growth of the plant. This is done by preparing a 10% sugar or gur solution in boiling water. This sugar solution is allowed to cool. On cooling 3 – 4 packets of guar bacterial culture are mixed with solution to make a thin paste. This paste is coated over to the seed. Seed is dried under shade for 30 – 40 minutes before sowing.
12. IRRIGATION
- Cluster bean is a drought tolerant crop therefore it requires less irrigation but to get maximum yield from irrigated areas 350 – 450 mm water is sufficient.
- For flood irrigated dry season crop needs irrigation at fortnightly intervals in the early summer and at ten days intervals later are given. Normally the crop requires 2 – 3 irrigations.
- The kharif season crop grown during rainy season as a rule does not need any irrigation if rains are adequate and well distributed. If rains are too heavy, the excess water should be drained off promptly.
- In water logging areas it is also grown as bosí crop (after sowing no irrigation is applied). If water is applied then crop bear no pods or less pods.

Typical Guar Irrigation Scheduling for Thal Desert Punjab Pakistan

<table>
<thead>
<tr>
<th>Month</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
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<tbody>
<tr>
<td>ETo</td>
<td>6.55</td>
<td>7.20</td>
<td>6.08</td>
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<td>Kc</td>
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<td>ET mm (Per day)</td>
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<td>31</td>
<td>31</td>
<td>15</td>
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<tr>
<td>ET mm for the Period</td>
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<td>194</td>
<td>146</td>
<td>46</td>
</tr>
<tr>
<td>Precipitation for the Period</td>
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<td>15</td>
<td>61</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>Net Water Requirement in mm</td>
<td>35</td>
<td>147</td>
<td>133</td>
<td>102</td>
<td>38</td>
</tr>
</tbody>
</table>

13. FERTILIZER
Guar crop needs 10 – 12 tons of well decomposed farmyard manure especially when it is being cultivated on poor sandy soils or after taking an exhausting crop. This manure is applied a month before sowing.
Nitrogenous fertilizers are applied only in small quantity because most of nitrogen to the crop comes from the atmosphere through bacterial action. DAP fertilizer about 125 kg, SOP 125 kg per hectare are applied as basal dose at the time of sowing.

14. WEED CONTROL
Guar field in kharif season is always full with a number of weed plants, Hoeing and weeding in the initial stages of plant growth with the help of khurpi; tined harrow reduces the weed-crop competition and increases soil aeration for bacterial growth. The application of Glyphosate (Roundup) as pre-emergence it suppresses the growth of grasses and other weeds.
15. DISEASES
Wilt of Guar, Fusarium solani and F. semitectum. This disease appears in early stages of the early crop. The infected plants suddenly start wilting. The leaves of the diseased plant first starts becoming yellow and then droop down. The diseased plants and debris should be removed from the field and destroyed. A proper crop rotation is also helpful in checking the build-up of inoculum potential in the soil.

16. INSECTS
It is attacked by a beetle which damages leaves by perforating them. This can be prevented by mechanical destruction in the early stage of the crop.

17. HARVESTING AND YIELD
The pods of the guar for green vegetable becomes ready for plucking, depending upon the variety, from 40 days onwards after sowing. Picking is done at an interval of 10 –12 days. When crop is grown for fodder the plants are cut when they are in flowering stage or when the pods are beginning to emerge. This stage comes 50 to 80 days after sowing. For green manuring, the crop can be ploughed down as soon as the pods begin to develop. The yield of the green crop is about 12 tons per hectare. When crop is grown for seeds, it is left until the pods are mature, then harvested with the help of sickles or combine harvester. After harvesting crop is dried and then threshed. Grain yield can be obtained from 6 – 20 maunds depending upon the crop growth and variety.
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